REMARKS

Applicants have amended the claims to more particularly define the invention taking into consideration the outstanding Official Action. Applicants have added new claims 25-30 to the present application (see paragraph [0018] to [0024] for support) to better define the invention. Applicants note that Applicants election without traverse of Species I, to which claims 1-4, 6 and 7 are readable, in the reply filed on May 23, 2007 is acknowledged. Claims 8-12, 15-18 and 20-24 are withdrawn from further consideration as reading on the non-elected species. Accordingly, Applicants have canceled claims 8-12, 15-18 and 20-24 from the present application. Applicants retain their right to file one or more divisional applications at a later time.

Applicants submit that the claims now present in the application are fully supported by the specification as originally filed and no new matter is introduced.

The rejection of claims 1-4, 6 and 7 under 35 U.S.C. §103(a) as being unpatentable over Applicant's Admitted Prior Art (AAPA) in view of Andricacos et al. has been carefully considered but are most respectfully traversed in view of the amendments to the claims and the following comments.

The Official Action urges that AAPA (paragraphs [0004] and [0005] and Figure 1 of the instant application) discloses an under bump metallization as recited in claim 1, including an under bump metallization layer comprising an adhesive layer, a first barrier layer, and a wetting layer, but expressly acknowledges that AAPA fails to disclose a second barrier layer disposed on the wetting layer wherein the material of the second barrier layer comprises tin and nickel.

The Official Action cites Andricacos as disclosing a second barrier layer of nickel-tin intermetallic disposed on a wetting layer and urges that it would have been obvious to combine the nickel-tin intermetallic on the wetting layer of AAPA for the purpose of preventing the reaction of the solder with the underlying copper. Applicants specifically traverse this combination.

Applicants begin by directing attention to col. 5, lines 5-8 of the Andricacos

reference. This portion of the reference discloses that the solder layer (which is analogous to the barrier layer recited in the instant application) may be nickel, cobalt, iron or alloys thereof. There is no disclosure in Andricacos that tin or an alloy including tin may be used as the solder layer. Thus, when expressly describing the solder layer (i.e., the barrier layer), Andricacos fails to disclose a solder layer comprising tin and nickel as recited in claim 1 of the instant application. Applicants respectfully submit this as the most concrete evidence that Andricacos does not disclose a barrier layer comprising tin and nickel. Although other portions of the Andricacos reference are cited as allegedly disclosing a second barrier layer comprising tin and nickel, these portions are ambiguous and confusing as compared to the clear statement at col. 5, lines 5-8 of Andricacos regarding the teaching of a solder/barrier layer.

The Andricacos reference (US 6224690) in column 5, line 13 to line 32 disclose that the nickel reacts with the tin-rich solder to form the nickel-tin intermetallic after reflow. It shows that the nickel-tin intermetallic is chemical compounds formed by nickel and tin. Because of the nickel-tin intermetallic is intermetallic compound, so that the nickel-tin intermetallic is not only chemically different from tin and nickel, but also different from the tin-nickel alloy.

In claim 25 of the present invention, the second barrier layer is tin-nickel alloy, and nickel-tin intermetallic of the Andricacos reference is not the same with the tin-nickel alloy. Furthermore, the nickel-tin intermetallic of the Andricacos reference is formed after reflow. However, the tin-nickel alloy of the present invention is not formed after reflow.

Applicants acknowledge that later portions of the Andricacos reference disclose the nickel solder layer may become a nickel-tin intermetallic when the solder ball is deposited and soldering is conducted to adhere the solder ball to the under bump structure. However, it is important to note that the intermetallic forms only after soldering has commenced and that the intermetallic formed is not a barrier layer. Rather, the formation of the intermettalic layer is the result of the transformation of the barrier layer, i.e., the result of the barrier layer serving its purpose and ceasing to be a

barrier layer. After a barrier layer begins to react with the material it is designed to prevent from passing through the barrier layer, it is not accurate to call the resultant structure a barrier layer. At best, the layer could be considered a "consumed" layer. Accordingly, citation to the intermetallic layer formed as the result of the consumption of the solder layer as reading on the claim limitation of a barrier layer is inaccurate and incorrect.

The Official Action places much emphasis on col. 5, lines 28-31 of Andircacos, which states "[f]urther, it prevents the reaction of the solder with the underlying copper." The Official Action urges that this means the intermetallic layer is a barrier layer since "it prevents the reaction of the solder with the underlying copper." However, Applicants respectfully submit that this statement of Andricacos is misleading and therefore misunderstood by the Official Action. This portion of Andricacos should be taken to mean that the consumption of the actual barrier layer (i.e., the solder layer made of nickel, copper, iron or alloys thereof) prevents the reaction of the solder with the underlying copper. The manner in which the actual solder layer (i.e., the solder layer made of nickel, copper, iron or alloys thereof) prevents reaction of the solder with the underlying copper is by providing material for the solder to react with. In this manner, no solder material will react with a layer below the solder layer because all of the solder reacts with the solder layer before it can reach the layer below the solder layer. Accordingly, this statement should be taken to mean that the nickel solder layer, and the consumption thereof, prevents the solder from reacting with underlying copper.

This interpretation is further supported by the fact that the interpretation advanced in the Official Action appears to be illogical. Barrier layers traditionally prevent material such as solder from reaching a layer below the barrier layer by providing material for the solder to react with. In the case of the invention described in Andricacos, this is accomplished by providing nickel as the material with which the tin solder may react. Once the intermetallic layer has formed (i.e., the nickel solder layer has reacted with migrating tin solder material to form an intermetallic), the layer will no longer have sacrificial material for the solder to react with in order to prevent migration

below the intermetallic layer. Thus, if soldering continues, it is entirely possible that tin from the solder will move past the consumed barrier layer (now a nickel-tin intermetallic) to the layers below the intermetallic layer. Thus, a nickel-tin intermetallic layer formed by the reaction between nickel in a barrier layer and migrating tin solder material cannot prevent the reaction of solder with an underlying copper as alleged in the Official Action. This would clearly be understood by one of ordinary skill in the art.

Thus, in order to explain the statement set forth in Andricacos, the interpretation advanced by Applicants above, i.e., that the reference is referring to the gradual transformation of the nickel solder layer to an intermetallic layer as preventing the reaction between the solder and the underlying copper, must be accepted.

As noted in the Amendment filed May 23, 2007, the fact that the nickel solder layer (and not the subsequently formed intermetallic layer) is disclosed in Andricacos as the means for preventing the reaction of the solder with the underlying copper means that the motivation statement set forth in the Official Action is improper. The Official Action alleges that Andricacos discloses that the intermetallic layer prevents reaction between solder and underlying copper and therefore it would be obvious to add the intermetallic layer to the structure of AAPA to accomplish this goal. However, as noted above, the ability to prevent reaction between solder and underlying copper is attributed to the nickel solder layer, not the subsequently formed intermetallic, and therefore this motivation statement cannot be properly used in support of the modification proposed in the Official Action.

With respect to the alleged motivation that it would be obvious to add an intermetallic as disclosed in Andricacos to the structure of AAPA because "it does not spall off or lose adhesion at the copper nickel interface," Applicants respectfully submit that this is not a motivation for combination, but rather is just a statement that the layer will not fail. One of ordinary skill in the art would not motivated to make a modification based on the assertion that such modification will not make the modified structure fail. There must be some positive benefit associated with the modification to provide motivation for the proposed modification.

For at least each of the forgoing reasons, Applicants respectfully submit that a proper §103 rejection according to the guidelines set forth in MPEP §2143 has not been established. More specifically, neither AAPA nor the Andricacos reference disclose or suggest every element of the claimed invention and the Official Action fails to provide the necessary motivation for making the proposed modification to AAPA based on Andricacos. Accordingly, Applicants respectfully request that the §103 rejection of claim 1 (and claims 2-4, 6 and 7 depending therefrom) be withdrawn.

Finally, with respect to claim 2, Applicants maintain the position that Andricacos fails to inherently disclose a barrier layer having a higher amount of nickel than tin and that the Official Action has not adequately supported this position of inherency.

In the outstanding Official Action, the Official Action cites col. 3, lines 5-10 of Liu et al. (US Pat. No. 6,744,142) in support of the inherency argument. This portion of Liu discloses a composite intermetallic compound adjacent the tin containing solder bump that may be Ni_6Sn_5.

Applicants respectfully submit that citation to one example of a compound wherein the amount of nickel is higher than the amount of tin does not support the position that the intermetallic in Andricacos inherently has more nickel than tin. The mere fact that one example has been found where the nickel content is higher than the tin content does not support the position that the intermetallic layer of Andricacos inherently has more nickel than tin. A barrier layer having less nickel than tin will still provide nickel for the solder to react with and promote adhesion of the solder to the underlying structure. Accordingly, the amount of nickel in a nickel-tin barrier layer can be higher or lower than the amount of tin and still serve as a barrier layer. Therefore, the amount of nickel compared to tin in a barrier layer is not inherently higher or lower and a specific teaching and motivation for combination is required before the subject matter of claim 2 may be deemed unobvious. Absent this specific teaching and motivation, Applicants respectfully submit that claim 2 is also patentable over AAPA and Andricacos, and therefore it is most respectfully requested that the §103 rejection be withdrawn.

In view of the above comments and further amendments to the claims, favorable reconsideration and allowance of all of the claims now present in the application are most respectfully requested.

Respectfully submitted,
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